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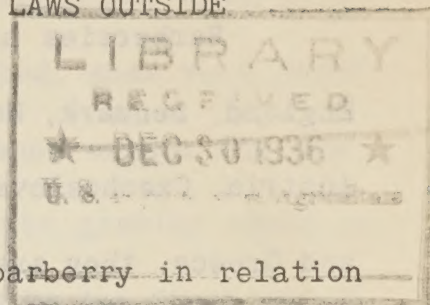
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United States Department of Agriculture
Bureau of Entomology and Plant Quarantine

RECENT INFORMATION REGARDING BARBERRY AND BARBERRY LAWS OUTSIDE
OF NORTH AMERICA

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The situation in Western Europe with respect to barberry in relation to rust was summarized in 1923 (31, 32)a/. Since that time, additional measures against the barberry have been enacted. In addition, the scope of the territory in which interest has been shown by investigators and legislators in the part the barberry plays in rust epidemics, in rust perpetuation, and in the production of new physiologic races has been considerably extended. The State of New South Wales in Australia has banned the barberry; the bush has been reported infected for the first time in South Africa and consequently is held in suspicion there; and rust has been collected on barberry in the Argentine, where the existence of susceptible species has been reported.

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Europe

Barberries are rare in Europe in the best grain-growing districts of England, Denmark, Holland, much of Germany, in France, Spain, Portugal, Italy, Austria, Czechoslovakia, and Hungary. In the mountains of Spain, France, Italy, and Greece, they are abundant in certain sections and are known to spread rust. In sections of Germany barberry is abundant also, and legislation against it has recently been found necessary in Schleswig-Holstein, while eradication is progressing on a large scale, under an old law, in Württemberg. Laws have also been put into effect in Rumania, Latvia, and Estonia.

In England, an enlightened public opinion has been responsible for the virtual elimination of stem rust through barberry eradication, without the aid of legislation. Close correlation between rust outbreaks and the presence of infected barberries has been evident also for many years in Wales, Scotland, and Ireland. Up to 1923 farmers in Wales had been less energetic than those in England in removing bushes, and rust at times caused considerable damage. In the period between 1928 and 1932, however, rust attacks were not reported to be frequent or severe on wheat (3), "even in those parts of South Wales in which the Common Barberry is still comparatively abundant." The rust occurred in a number of counties of England "as well as in mid- and South Wales." Stem rust on oats was observed in northernmost England in 1932 (3) and "was reported as abundant in Cumberland in 1931," the adjacent county on the southwest. In Scotland, oats is the most important small-grain crop; little wheat is grown. In 1926, Miss Maxwell (24) reported that heavy infection on cereals and grasses in Scotland was noted only in the immediate vicinity of affected barberry bushes, which were widely distributed over southern Scotland. It was her opinion that the eradication of the bushes would almost certainly result in the disappearance of the rust. At present, bushes are removed under advice of

county agents. A study at University College, Dublin, Ireland, on Puccinia graminis avenae and Berberis spp. was reported by the Agricultural Faculty in 1930-31 (5). Of a large collection of Berberis spp. studied, some were found to be susceptible, but probably none of practical importance except the common barberry, from which rust had spread to plots of oats growing about a mile westward of the barberry garden. This was reported to be the first record of oat stem rust in that locality. While this isolated instance of rust spread may not be of practical importance, it adds to current evidence against the barberry.

In Denmark, legislation in 1869 and in 1904 has brought about virtual elimination of rust through barberry eradication. Yet as late as 1922 (13) bushes were found infected in several localities, including Møen's Klint, an island off the southwestern coast of Zealand, where cultivation of barberry was still permitted. Those who made the survey considered it urgent to extend eradication requirements to this island.

In Sweden, where barberry is abundant in some sections, including parts of the South (21), there has been considerable agitation for a number of years for more effective legislation against barberry. The law of 1918 did not prove adequate. Objections to drastic legislation were raised by Frederickson (11) in 1926, on the grounds "(a) that other factors besides the vicinity of barberry bushes are involved in the proximity of epidemics; (b) that the salt treatment is not altogether effective; and (c) that the high cost of eradication may be altogether disproportionate to the advantage arising therefrom." Henning (14), in the same year, while admitting the justice of certain of these criticisms, urged the necessity of eradication (15). He referred to Denmark's regulations and particularly to the rust situation on the island of Møen, mentioned previously, where barberry cultivation is permitted. In addition, he proposed eradication as work for the unemployed (16). Eradication

also was urged by Lindfors (21), who reported that prospects of a good wheat harvest in 1929 were spoiled by rust, particularly near Lake Maeler, where bushes were so prevalent that scarcely a field could escape infection. The following year the distribution of barberry in the south Stockholm district was mapped by Arrhenius (6), and Hermelin (17) supported Lindfors in his plea for eradication as a rust-control measure. On Hermelin's farm "the bushes had been uprooted at the rate of about 200 a day, so that the general fear of an excessive outlay of time and labour on the work is probably exaggerated." In 1933, Lindfors (22, 23) published figures on the cost of eradication and reported on the new amendment of May 26, 1933, to the barberry eradication law of 1918, by which the regulations in a number of districts were "made to apply to other Berberis varieties as well as B. vulgaris, irrespective of their distance from cultivated land, which was formerly fixed at 200 m." Directions also were given for eradication by means of salt and spraying with sodium chlorate. How effectively the new legislation will be carried out remains to be seen.

The Norwegian law against the barberry was passed in 1916.

Holland accomplished eradication without the aid of legislation.

The first law against the barberry in Germany was passed in 1805 in Schaumburg-Lippe; since that time more than 25 local laws or police orders have been enacted, as recently as 1927 in the Magdeburg district (2) of northern Germany and in 1933 in Schleswig-Holstein (4). In the latter province, a police regulation of March 27, 1933, modified the eradication order of August 7, 1930, to prohibit within 200 m. of arable land the growing of 14 species of Berberis, the eradication to be done by owners of the barberry property. As a result of the campaign in Germany for increased cereal production, it was estimated in 1933 that from 75 to 90 percent of the land in

Schleswig-Holstein was under cereal cultivation. Wheat and barley were replacing the hardier oats and rye, and the attendant problems were becoming evident. The protective measure of barberry eradication accordingly was considered desirable. In the Magdeburg district, a police regulation of March 13, 1926, provides for the compulsory destruction of all barberry bushes within 200 m. of fields sown to cereals, as a measure directed towards the control of Puccinia graminis. In Württemberg (18, 19), southern Germany, the aid of an old police order against plant pests was recently invoked, and eradication was begun in earnest in October 1934. During the winter season 1934-35, about 60,000 barberry bushes are definitely known to have been destroyed in three areas in which they were particularly abundant, and the total number removed in the province was much larger. The law reads as follows:

"The eradication of barberry in Württemberg can be ordered by the individual district authorities on the basis of the Württemberg police penalty law Art. 33, No. 2. According to the provision in Paragraph 368 of the list of penalties the following are penalized: No. 2: He who does not comply ... with the police order with respect to the destruction of harmful animals and plants. The local mayor is responsible for the penalty decree."

Every year rust was noted in various sections of the province. In 1926, as much as 60 percent was reported on wheat in one section, from 10 to 50 percent in other sections, and 15 percent on barley. Rye and oats also were rusted. From the Ulm district, at Westertetten, in the same year, the statement came "that wheat and spelt, because of heavy rust attack, must be harvested before maturity." In the latter district in 1933 there also was heavy rust. In various communities "the wheat plants were covered all over with black stem rust pustules, and even the heads showed severe attack." In the summer of 1934, when, "because of the long-enduring drought, other places showed only very little stem-rust destruction, we could observe, in those territories where barberries were abundant, severe damage done by stem rust, especially

on wheat and spelt." Observations made in 1934 throughout Württemberg indicated clearly that barberries acted as centers of infection (18). Every wheat, spelt, and rye field examined was rusted, and often every plant. On the basis of the study of the situation made before eradication was decided upon definitely, Lehmann wrote as follows:

"It is not to be doubted that a successful fight against black rust can be carried out by means of barberry eradication at least in Württemberg as in other parts of southwest Germany, and by this means heavy losses in straw and grain be avoided. The following facts, if we wish to summarize briefly, speak therefor:

"1. The close relation we have established between stem-rust outbreaks and the occurrence of barberries in Württemberg;

"2. The lack of stem rust in areas of Germany in which the barberry is almost entirely lacking or occurs only sporadically (e. g. Schleswig-Holstein, Hannover.);

"3. The occasional severe outbreak of stem rust in consequence of new plantings of susceptible barberries by nurseries in areas with few barberries (Schleswig-Holstein);

"4. The frequent stem-rust outbreaks in areas in which barberries have been known to be very common for some time (Voralpen area);

"5. The impossibility, recently demonstrated, of uredial overwintering in Germany;

"6. The fact that the transportation of stem-rust spores by air currents from other countries to Germany need be reckoned with only to a limited extent, for, in the first place, important barriers in the form of mountain ranges stand between, and furthermore, because in our areas stem rust appears very late at the earliest, usually shortly before harvest;

"7. The causal relation between the occurrence of barberries and outbreaks of stem rust in other countries;

"8. The enduring success of barberry eradication in several countries (Denmark, England, U. S. A., and others)."

He points out that breeding for rust resistance in this case is complicated by the multiplicity of cereal varieties grown and by the presence of physiologic races. Thus barberry eradication was undertaken as an immediate control measure. This will be followed by rust surveys each summer in the areas

in which barberry has been eradicated and, by way of comparison, in those areas in which barberry is still common.

Eradication proceedings were preceded by the education of farmers and local officials as to the desirability of the removal of bushes. Public meetings were held, to which were invited leaders of local farmers' societies, teachers, mayors, and foresters. This was supplemented by field trips to see barberry bushes growing and for explanation of the proposed methods of eradication. Printed material was distributed. Work was begun in one area, and with this as a basis and through a gradual process of education and actual experience the scope of the work was enlarged. Supervision was under the leaders aforementioned. Cooperation of school pupils, as in the United States, was solicited in locating bushes. Eradication by owners was made compulsory under the old police order; bushes on public properties and on boundary lines between properties were to be removed through cooperative effort, under special provision made for various situations. The towns aided in large undertakings by donating a certain amount of labor or money, and communities paid for the salt used, tax-free. Bushes were pulled out by five or six men, with the aid of chains and jacks; roots were dug out as well as possible, and salt was then applied. Bushes were left to be burned the following spring. Under the law, fines for nonremoval of barberries could be imposed, and it is stated--

"To be expedient and necessary in those territories within whose boundaries the barberry occurs especially abundantly, to publish local police notices about the ... extermination of barberry. From every mayor a report of barberry eradication in his territory was required to May 1, 1935."

The campaign in any district, however, was preceded by education of farmers and officials as to the desirability of eradication of the bushes, and to this fact must be attributed much of their success.

Latvia (12) enacted a ban against the barberry in March 1930, requiring owners of barberry properties to destroy all bushes by March 1933. In 1932 the time set for completion of the work was postponed to 1935. During the first three years, over 50,000 bushes of B. vulgaris were destroyed by the Department of Forests on State-owned forest lands. In November 1932, a similar measure was made law in Estonia (1, 34). A communication from Ümarik follows in part:

"In Estonia the cereals are often attacked by rusts. It is especially in the North-West of the country that the cereals suffer from this disease which sometimes causes severe damage to the cultivated crop. In southern Estonia, the damage which the cereals suffer is notably less important. The reason for this is, that in the South the barberry (Berberis vulgaris L. and var. atropurpurea Hort.) is found solely in parks and gardens and rarely in the wild state, whereas in the North-West, it commonly grows in the wild state on Silurian soil. The buckthorn (Rhamnus cathartica L.) is to be found throughout the country, but to a much less extent than the barberry.

"In order to control the rusts of cereals (Puccinia graminis Pers. and P. coronifera Kleb.) Parliament passed a special law at the Assembly of the 18th November, 1932, which renders compulsory the destruction of barberry and buckthorn.

"Within a period of three years every bush of barberry and buckthorn must be destroyed by the owners of the land or by the usufructuaries, in the case of lands belonging to the State. During the first year the destruction must be directed against all bushes in gardens, in fields, within a radius of 200 yards around the fields, and in meadows. During the following two years these bushes everywhere else must be destroyed.

"The Ministry of Agriculture is authorised to protract the date fixed by the law, if in special cases it appears indispensable. The Ministry may also allow the work of destruction to be suspended in districts where the barberry and the buckthorn offer no danger to agriculture.

"The owners and usufructuaries of land are obliged to see that the destroyed bushes do not grow up again.

"The cultivation of the above mentioned plants in a district where their destruction is compulsory is allowed only for a scientific purpose, and at the authorisation of the Minister of Agriculture.

"Every usufructuary of land is authorised to request that the law in question be put into force, and to apply in this matter to the authority of the police for them to take the necessary steps.

"In the case of owners and usufructuaries who do not effect the destruction according to the law, the necessary work will be undertaken by the local authorities at the expense of those interested."

Estonia, Lepik (20) points out, is favorably situated for the control of rusts by eradication of alternate hosts. On the west is the Baltic Sea and north the Gulf of Finland to offer some protection; while adjoining on the south is Latvia, where eradication was begun in 1930. At the eastern border lies Lake Peipus, with a maximum width of 15 miles, and beyond it large forests and swamp areas; these constitute some hindrance to wind-blown spores from that direction.

There is less information available regarding the situation in the Union of Soviet Socialist Republics. It is known, however, that the following rust-susceptible species of barberry (33) are found in various regions of the Union:

<u>Berberis amurensis</u> Rupr.	Far Eastern region
<u>B. aquifolium</u> Pursh.	Crimea
<u>B. heteropoda</u> Schr.	Kirghizia, Syrdaria
<u>B. integerrima</u> Bunge a/	Turkmenia
<u>B. nummularia</u> Bunge a/	E. Turkistan
<u>B. oblonga</u> Schn.	Tadzhikstan, Uzbekistan
<u>B. orientalis</u> Schn. a/	Azerbaijan
<u>B. sibirica</u> Pall.	S. Siberia, N. Mongolia
<u>B. vulgaris</u> L.	European Russia, W. Siberia

A barberry law has been in effect in Austria since 1882, and in Hungary since 1920. Bushes now occur mainly in the mountains, as in Czechoslovakia. In 1932, Rumania (28) undertook an active campaign against the barberry, setting aside a week in November for the destruction of the bushes through cooperation of various Government departments. In April of the following year (29) the Plant Protection Service took in hand the eradication of barberry. Severe damage due to stem rust occurred in 1932 and 1933. In 1932, according to Savulescu et al. (30), the rust appeared on leaf blades, sheaths, stems, a/ Puccinia graminis reported for the first time on these species.

and ears. In May of the following year, teliospores which had been found in the soil to the number of 4 per sq. cm. germinated and barberries became heavily infected. It was the most severe attack ever recorded in Rumania. Barberries in all areas were infected. In one locality between May 14 and 20, 50 aecia were counted on a single leaf. Wheat fields surrounded by barberry bushes sustained heavy losses from black rust, which decreased in severity as the distance from the bushes increased. It is of interest to eradicators in the United States to know that these countries are situated so as to be subject to wind-blown inoculum from areas to the south and southeast or southwest. Overwintering is not a factor in the area near Vienna (7) in Austria or in Rumania (30).

France has a crop-pest law dating from 1888, and under this there are local eradication laws. Barberries are now largely absent from the plains and, according to Foex, there is little rust. In the Alps, however, bushes are common, and in these districts, in the opinion of Costantin (10), it would be possible to establish a rust-free zone by eradicating barberries. Since teliospores are more resistant to cold and severe weather conditions than uredospores, barberry can keep rust going at higher altitudes than rust would ordinarily be able to persist. Therefore if wheat is to be grown at high altitudes, eradication is necessary. Since the bushes were removed from the plains of France rust is no longer the great enemy of grain, but rust infection is still heavy in the mountains, because of the abundance of barberry, especially near Briançonnais. Costantin points to the absence of rust in northern and western Sweden, due to the absence of barberry. He also points to the higher yields of grain at higher altitudes in Canada. In this case, of course, the rust that causes most damage in France -- P. glumarum -- would remain, but in the proposed sanitary zone in the mountains it might be possible, in the opinion of this author, more easily to ascertain the varieties resistant to

P. glumarum, and in addition the altitude might have some effect on this rust as well as in the case of P. graminis.

In Spain there are barberries in the mountains also, and elsewhere in the country, but rust overwinters sometimes and so can be independent of the aecial stage. Barberries are rare in Portugal, according to Bensaude (8), who reported in 1930 as follows:

"As barberry bushes are exceedingly uncommon in Portugal, where only B. vulgaris is known, it is thought more probable that P. graminis may be present summer and winter on Gramineae without producing aecidiospores on barberry. Infection may originate from spores blown from bushes in neighboring parts of Spain."

In the mountains of northern Italy, barberry bushes are abundant and rust most important. Farther south rust is relatively unimportant. In 1930, however, at Perugia (9) in central Italy, aecial infection was found on a clump of common barberry growing near a place where wheat was threshed each year. The bushes had not been infected in the two preceding years or in the following year.

Berberis cretica in the mountains of Greece are a source of considerable rust, since the bushes are abundant. And since the hot summers prevent uredial oversummering of the rust, the barberries also are important.

Australia

New South Wales has been the most recent to ban the barberry. Under the Plant Diseases Act of 1924, the Governor of New South Wales issued two proclamations on July 9, 1935, which called for barberry eradication by owners and occupiers of land as a protection against Puccinia graminis. The proclamations read as follows:

"PLANT DISEASES ACT, 1924
Proclamation a/

A. Hore-Ruthven,
Governor.

"I, the Honourable Sir ALEXANDER GORE ARKWRIGHT HORE-RUTHVEN, Governor of the State of New South Wales and its Dependencies in the Commonwealth of Australia, by virtue of the powers conferred upon me by section 3 of the Plant Diseases Act, 1924, and with the advice of the Executive Council, do hereby declare the following disease of plants, namely, Puccinia graminis (rust in wheat) to be a disease for the purposes of the said Act.

"Signed and sealed at Sydney, this 9th day of July, one thousand nine hundred and thirty-five. By His Excellency's Command,

HUGH MAIN.

GOD SAVE THE KING"

"PLANT DISEASES ACT, 1924
Proclamation a/

A. Hore-Ruthven,
Governor.

"I, the Honourable Sir ALEXANDER GORE ARKWRIGHT HORE-RUTHVEN, Governor of the State of New South Wales and its Dependencies in the Commonwealth of Australia, by virtue of the provisions of section 5 of the Plant Diseases Act, 1924, and with the advice of the Executive Council, do hereby require every owner and every occupier of land throughout the State to destroy every plant known as Common Barberry (Berberis vulgaris) growing upon such land, for the prevention of the spread of the disease known as Puccinia graminis (rust in wheat).

"Signed and sealed at Sydney, this 9th day of July, one thousand nine hundred and thirty-five. By His Excellency's Command,

HUGH MAIN.

GOD SAVE THE KING"

Stem rust was introduced into Australia in packing straw from England about 1840. McAlpine stated that barberries did not rust in Australia because the black stage of the rust had become functionless; this was commonly believed and taught until recently. In 1921, Waterhouse (36) infected barberry experimentally with rust on wheat from Glen Innes. In 1928 he (37) showed that a new form of rust may be produced on the barberry. He produced infection on bar-

berry with wheat straw carrying form 34, the common form in Australia, from two locations, and with straw infected with a mixture of 34 and 43 from another location. From the barberry thus infected were isolated forms 11, 34, and a form not previously found in Australia, although hundreds of collections had been identified. Waterhouse pointed out that, since barberries were widespread in North America and forms numerous, and since the opposite was true in Australia, the alternate host should be eradicated as a preventive measure. He further pointed out that the presence of barberries complicated their wheat-breeding problem, since Hope, which was resistant to known forms of rust in Australia and accordingly was being used as parental material, proved susceptible (in the greenhouse) to form 11. Then in 1933 (38), for the first time, natural infection was found on barberry:

"In December, 1933, Messrs. Allman and Dwyer found infected barberries growing under natural conditions at Yetholem, N. S. W. The rust proved to be P. graminis tritici 34. The same form was present on Agropyron scabrum growing intermixed with the barberries. Old stems of this grass were heavily infected with the teleutosori which were doubtless the source of the barberry infection. The same grass growing a considerable distance away from the barberries was attacked by the same rust. Rust-susceptible barberries should be eradicated."

In the two succeeding years, form 11 was collected in the field for the first time (39). These results led to the official proclamation against the barberry, an ounce of prevention, in their opinion, being worth a pound of cure.

In the State of Victoria, there are a number of barberry species, but no record so far of escaped plantings or infection on barberry (26). Stem rust, however, is capable of causing considerable damage, the estimate being as much as five million pounds in a single season.

Africa

In South Africa, also, barberry is considered as a possible menace to wheat-growing. Verwoerd (35) obtained infection on B. vulgaris artificially with Puccinia graminis tritici, P. graminis avenae, and P. graminis secalis, and thus disproved the general conception that absence of the alternate host resulted in a loss of the power of infection. He states:

"Though the results have been obtained under artificial conditions, the necessity of prohibiting the importation of barberries is nevertheless important in safeguarding the development of resistant cereal varieties. It is considered possible for barberries to spread to areas where low winter temperatures prevail and where the teleutospores on grass or cereal hosts may undergo a natural process of maturation, infecting the barberry and originating a source for the development of unknown physiologic forms.'

Similar attempts to obtain infection in Kenya have so far been unsuccessful (25).

South America

Stem rust is known to cause as much as 50 percent loss in wheat in Argentina (27). At least two rust-susceptible species of barberry have been reported, the majority being in the southern part of the country and in southern Chile: B. buxifolia Lam. (or B. dulcis Sweet) and B. ilicifolia Forst. (or B. serratodentata Lechl.). The latter also is found in Uruguay. Aecia have been collected on B. buxifolia, but it is not known whether other species rust or how important barberry is as an alternate host. The climate is so mild that the presence of barberry would not appear to be required. However, there are four known physiologic forms and, in the words of Rudolf, the "existence of Barberis spp., especially B. buxifolia, makes probable the continual production of new forms of P. graminis tritici on them."

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